SECTION 501
EXCAVATION AND BACKFILL FOR STRUCTURES

501.1 GENERAL

The work performed under this specification shall include, but not be limited to providing the equipment, labor and materials for the excavation and backfill of areas related to structures, such as bridges, foundations, walls, storm drain inlets, as specified on the plans and therein or as authorized by the ENGINEER.

501.2 REFERENCES

501.2.1 American Society for Testing Materials (Latest Edition)(ASTM)

C136 Test for Sieve or Screen Analysis of Fine and Coarse Aggregate
D422 Particle-Size Analysis of Soils
D423 Test for Liquid Limit of Soils
D424 Test for Plastic Limit and Plasticity Index of Soils
D698 Moisture-Density Relations of Soils Soil-Aggregate Mixtures Using 5.5-lb (2.49-kg) Rammer and 12-in.(305mm) Drop
D1140 Amount of Materials In Soils Finer Than No.200(75um)Sieve
D1557 Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb(4.54-kg)Rammer and 18-in. (457mm) Drop
D2922 Density of Soil and Soil Aggregate In-Place by Nuclear Methods
D3017 Moisture Content of Soil and Soil Aggregate In-Place by Nuclear Methods
D4253 Maximum Density of Soils using a Vibratory Table
D4254 Minimum Index Density of Soils and Calculation of Relative Density

501.2.2 This Publication:
Section 207 Lean Fill Construction
Section 301 Subgrade Preparation

501.3 EXCAVATION

501.3.1 All excavation for structures shall be made in accordance with applicable regulations such as the Department of Labor's Occupational Safety and Health Administration Standards 29CFR Part 1926, Subpart P or any applicable amendments.

501.3.2 When slope limit for structural excavation is shown on the plans, those limits are to establish the pay quantities for structural excavation and backfill only and in no way shall relieve the CONTRACTOR from meeting the requirements of 501.3.1 above.

501.3.3 The bottom width of the excavation shall be a minimum of the bottom width of the structure foundation plus one foot (1') on each side to provide space for erection and removal of forms. Additional bottom area may be required due to the type and size of compaction equipment the CONTRACTOR chooses to use.

501.3.4 CONTRACTOR shall be responsible for obtaining and maintaining a temporary storage site for usable excavated material during the period of construction. CONTRACTOR may request through the ENGINEER, approval of the OWNER to store excavated material within the street right-of-way or on City property.

501.4 COMPACTED BACKFILL

501.4.1 Backfill material shall be either Class I, II, III, or Class IV soils as defined in TABLE 501.4.A, or Lean Fill complying with the requirements of Section 207. The CONTRACTOR shall not place backfill against a portland cement concrete structure until the concrete has attained 80% of the design strength as determined by the average strength of two field cured cylinders. The field cured cylinders shall be cured in the field under the same condition as the concrete in the structure, represented by the cylinders.

501.4.2 The CONTRACTOR shall remove unsuitable material which either will not compact readily or serve the intended purpose and replace it with suitable material as authorized by the ENGINEER.

501.4.3 All forms, braces, and debris shall be removed before start of backfilling.

501.4.4 Backfill material shall be placed in level lifts and each compacted lift shall not exceed 6 inches.

501.4.5 Soil used for the backfill around structures shall be compacted to a dry density of not less than 90% of maximum dry density in a moisture range of optimum moisture +/-2% as determined in accordance with ASTM D1557 (modified), unless the soil contains 35% or more finer than the No. 200 sieve. If the soil used has 35% or more finer than the No. 200 sieve, it shall be compacted to a dry density of 90% of maximum dry density in a moisture content range of at least optimum moisture to +4% above optimum as determined in accordance with ASTM D698 (Standard).

501.4.6 When structural backfill is within the roadway area, this area shall be compacted to 90% dry density as specified in 501.4.5 and rework and compacted to 95% dry density at the same time as the surrounding subgrade area is compacted as specified in Section 301.

501.5 GRAVEL DRAINS

501.5.1 The construction plans may require the installation of weep holes in the concrete walls to relieve the surcharge pressure of ground water. Gravel drains are intended to provide a drainage course to the weep holes. The size, shape, and

TABLE 501.4.A

EMBEDMENT SOILS CLASSIFICATIONS

SOILS CLASS	SOIL TYPE	DESCRIPTION
CLASS I SOILS*		Manufactured angular, granular material, 1/4 to 1-1/2 inches (6 to 40 mm) size, including materials having regional signficance such as crushed stone or rock, broken coral, crushed slag, cinders, or crushed shells, complying to the requirements of Class II soils.
CLASS II SOILS**	GW	Well-graded gravels and gravel-sand mixtures, little or no fines. 50% or more of coarse fraction retained on No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
CLASS II SOILS**	GP	Poorly graded gravels and gravel-sand mixtures, little or no fines. 50% or more of coarse fraction retained on No. 4 sieve. More than 95% retained on No. 200 sieve. Clean
CLASS II SOILS **	SW	Well-graded sands and gravelly sands, little or no fines. More than 50% of coarse fraction passes No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
CLASS II SOILS**	SP	Poorly graded sands and gravelly sands, little or no fines. More than 50% of coarse fraction passes No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
CLASS III SOILS***	GM	Silty gravels, gravel-sand-silt mixtures. 50% or more of coarse fraction retained on No. 4 sieve. More than 50% retained on No. 200 sieve.
CLASS III SOILS***	GC	Clayey gravels, gravel-sand-clay mixtures. 50% or more of coarse fraction retained on No. 4 sieve. More than 50% retained on No. 200 sieve.
CLASS III SOILS***	SM	Silty sands, sand-silt mixtures. More than 50% of coarse fraction passes No. 4 sieve. More than 50% retained on No. 200 sieve.
CLASS III SOILS***	SC	Clayey sands, sand-clay mixtures. More than 50% of coarse fraction passes No. 4 sieve. More than 50% retained on No. 200 sieve.
CLASS IV SOILS	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands. Liquid limit 50% or less. 50% or more passes No. 200 sieve.
CLASS IV SOILS	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. Liquid limit 50% or less. 50% or more passes No. 200 sieve.
CLASS IV SOILS	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts. Liquid limit greater than 50%. 50% or more passes No. 200 sieve.
CLASS IV SOILS	CH	Inorganic clays of high plasticity, fat clays. Liquid limit greater than 50%. 50% or more passes No. 200 sieve.
CLASS V SOILS	OL	Organic silts and organic silty clays or low plasticity. Liquid limit 50% or less. 50% or more passes No. 200 sieve.
CLASS V SOILS	OH	Organic clays of medium to high plasticity. Liquid limit greater than 50%. 50% or more passes No. 200 sieve.
CLASS V SOILS	PT	Peat, muck and other highly organic soils.

* Soils are as defined in ASTM D2487, except for Class I Soil which is defined in ASTM D2321.
** In accordance with ASTM D2487, less than 5% passes No. 200 sieve.
***In accordance with ASTM D2487, soils with 5% to 12% passing No. 200 sieve fall in a borderline classification that is more characteristic of Class II than of Class III.

location of the gravel drain will be shown on the construction plans.

501.5.2 Gravel drain material shall consist of a material complying with the following gradation, and having the same or similar gradation curve as defined by the specification limits when graphically plotted on a standard aggregate gradation chart.

SIEVE SIZE	% PASSING
3 inch	100
1/2 inch	70 - 100
no. 4	50 - 80
no. 16	25 - 50
no. 50	5 - 15
no.200	0 - 5
Liquid Limit	NV (no value)
Plasticity Index	NP (non plastic)

**The drain material shall comply with the following material size ratios:

$$12 < / = R50 < / = 58$$

$$R50 = \frac{\text{50-percent size GDM}}{\text{50-percent size BM}}$$

$$12 < / = R15 < / = 40$$

$$R15 = \frac{\text{15-percent size GDM}}{\text{15-percent size BM}}$$

where

GDM - represents the Gravel Drain Material
BM - represents the Base Material (surrounding soil)

501.5.3 A separator (membrane type) geotextile fabric shall be used to encase the Gravel Drain Material in areas where the surrounding soild has 30% or greater of its material passing the no. 200 sieve.

501.6 MEASUREMENT AND PAYMENT

501.6.1 Measurement:

501.6.1.1 Unless specified on the plans, in the Supplemental Technical Specification and/or in the Bid Proposal no separate measurement will be made for excavation and backfill for structures. This work shall be considered incidental to and part of the cost of the structure.

501.6.1.2 When specified on the plans, in the Supplemental Technical Specifications and/or in the Bid Proposal excavation and backfill for structures shall be measured by the cubic yard of excavation.

501.6.1.3 Gravel drains will be measured by the cubic foot based on the neat line volume shown on the plans or as authorized by the ENGINEER.

501.6.2 Payment:

501.6.2.1 Payment for excavation and backfill for structures shall be made at the contract unit price per structure or per cubic yard of excavated quantity, complete in place, which price shall include all equipment, labor and materials required to excavate, stock pile, backfill, compact, and the removal and disposal of excess material.

501.6.2.2 Payment for gravel drains shall be made at the contract unit price per cubic foot, complete in place, which price shall include all equipment, labor and materials required in furnishing the gravel and geotextile fabric, the installation of both and the compaction required.